NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WETLAND RESTORATION

(Acre)

CODE 657

DEFINITION

The rehabilitation of a degraded wetland or the reestablishment of a wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition that existed prior to modification to the extent practicable.

PURPOSE

To restore wetland function, value, habitat, diversity, and capacity to a close approximation of the pre-disturbance by:

- Restoring composition and function of hydric soil
- Restoring hydrology (depth duration and season of inundation, and/or duration and season of soil saturation).
- Restoring native vegetation (including the removal of undesired species, and/or seeding or planting of desired species).

CONDITIONS WHERE PRACTICE APPLIES

This practice applies only to natural wetland sites with hydric soils, or problem soils that are hydric, which have been subject to hydrologic or vegetative degradation, or to sites where hydric soils are covered by fill, sediment, or other deposits.

This practice is applicable only where the natural hydrologic conditions, including the hydroperiods, can be approximated by modifying drainage and/or by artificial flooding of a duration and frequency similar to the original, natural conditions.

This practice does not apply:

- to treat point and non-point sources of water pollution (Constructed Wetland - 656);
- to modify an existing wetland where specific attributes are heightened by management objectives, and/or returning a degraded wetland back to a wetland but to a different type than what previously existed on the site (Wetland Enhancement - 659);
- to creating a wetland on a site location which historically was not a wetland (Wetland Creation - 658).

CRITERIA

General Criteria Applicable to All Purposes

The purpose, goals and objectives of the restoration shall be clearly outlined, including soils, hydrology and vegetation criteria that are to be met and are appropriate for the site and the project purposes.

The soil, hydrology and vegetative characteristics existing on the site and the contributing watershed shall be documented before restoration of the site begins.

This practice may adversely affect cultural resources. Planning, installation and maintenance must comply with GM 420, Part 401, *Cultural Resources (Archeological and Historic Properties)*.

Upon completion of the restoration, the site shall meet soil, hydrology, vegetation and habitat conditions of the wetland that previously existed on the site to the extent practicable.

When the anticipated disturbance will be greater than or equal to one (1) acre, an erosion control permit must be obtained from the Vermont Agency of Natural Resources, Department of Environmental Conservation, Water Quality Division. The permit will require the development of an Erosion and Sedimentation Control Plan which must be followed throughout construction.

Where offsite drainage or the presence of invasive species impact the site, the design shall compensate for these landscape changes (e.g., increased water depth, berms or microtopography).

Sites suspected of containing hazardous waste shall be tested to identify appropriate remedial measures. Sites containing hazardous material shall be cleaned.

Domestic livestock will be excluded from the wetland, wetland buffer and erosion control area.

Invasive species, federal/state listed noxious plant species, Vermont Invasive Plant Watch List and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site. This includes the manipulation of water levels to control unwanted vegetation. The establishment and/or use of non-native plant species shall be discouraged where possible.

Criteria for Hydric Soil Restoration

Restoration sites will be located on hydric soils, or on problem soil areas that are hydric.

If the hydric soil is covered by fill, sediment, spoil, or other depositional material, the material covering the hydric soil shall, to the extent technically feasible, be removed.

Criteria for Hydrology Restoration

The hydrology (including the timing of inflow and outflow, duration, and frequency) and hydroperiod of the restored site shall approximate the conditions that existed before alteration. This includes affects to hydrology restoration caused by roads, ditches, drains, terraces, etc. within the watershed.

The work associated with the wetland shall not adversely affect adjacent properties or other water users unless agreed to by signed written letter, easement or permit.

A natural water supply should be used to reestablish the site's hydrology that approximates the needs of the wetland type. If this is not possible, an artificial water supply can be used; however, these sources shall not be diverted from other wetland resources (e.g. prairie pothole wetland complexes or springs).

To the extent technically feasible, reestablish topographic relief and/or microtopography. Use reference sites within the area and historic aerial photography to determine desired topographic relief.

Excavations from within the wetland shall remove sediment to approximate the original topography and/or microtopography or establish a water level that will compensate for the sediment that remains.

The acceptable methods of restoring the hydrology of a site are: low embankments, depressions, ditch plugs and tile breaks.

Low embankment structures, depressions, ditch plugs and tile breaks shall be designed in accordance to this standard.

Criteria for Low Embankment Structures

Structures are considered low embankment if all the following apply:

1. The embankment does not cross a perennial stream.
2. The maximum height of fill, measured from the lowest point at the downslope toe of embankment to the top surface of the fill along the centerline of the embankment does not exceed six (6) feet.
3. Failure of the embankment will not result in: loss of life; damage to homes, commercial or industrial buildings, main highways, or railroads; or interruption of the use or service of public utilities.

General Criteria for low embankments structures shall be as follows:

1. The embankment top width will be a minimum of six (6) feet.
2. All drains shall be plugged according to the distances listed in Table 1. The plug shall be installed from downslope edge of the core trench if one is required or the centerline of the embankment extending upslope.

3. A core trench shall be provided under the embankment if more than two (2) feet of water is impounded.
4. Install anti-vortex devices, trash guards and beaver protection on water control structures as appropriate.
5. All vegetation and topsoil will be removed from the "foot print" of the embankment. The design height of the embankment shall be increased by the amount needed to insure that after settlement, the actual height of the embankment equals or exceeds the design height. The increase shall be not less than 5 percent.
6. Seeding of embankment shall be in accordance to Practice Standard 342 – Critical Area Planting.

Table 1 – Minimum Length of Drain to be Removed

Permeability (in/hr)	Soil Texture	Minimum Distance (feet)
> 2.0	Sand and Organics	75
0.6 to 2.0	Loam	50
<0.5	Clay	25

Additional Criteria for low embankment structures (see Table 2) where the contributing watershed is less than 50 acres and the drainage area average slope is less than 10 percent shall be:

1. The structure must safely pass a 10 year – 24 hour storm frequency. The earth embankment crest may serve as a service spillway where flows are infrequent enough to establish and maintain vegetation on the embankment. When frequent flows are anticipated, a water control structure or erosion resistant spillway shall be installed to help maintain and establish vegetation on the embankment.

Table 2. Embankment slopes and minimum auxiliary spillway capacity

Watershed			Min. design storm[1]	
Drainage Area (Acres)	Average Slope (%)	Embankment Slopes	Frequency (Years)	Minimum Duration (Hours)
≤ 50	< 10	5:1 or flatter	10	24
> 50	≥ 10	3:1 or flatter	25	24

1. Select rain distribution based on climatological region.

Additional Criteria for low embankment structures where the contributing watershed is equal to or greater than 50 acres and/or the drainage area average slope is equal to or greater than 10 percent shall be:

1. A spillway system shall be provided that includes a principal spillway and an auxiliary spillway. The principal spillway and the auxiliary spillway can be combined into a single erosion resistant spillway capable of handling the full design discharge. The combined spillway shall be designed to discharge the runoff from a 25 year – 24 hour storm event. For drainage areas less than 100 acres, the minimum pipe diameter will be 8 inches. For drainage areas equal to or greater then 100 acres, the minimum pipe size shall be 12 inches. A drainage diaphragm shall be used on all pipes larger than 12 inches in diameter. The drainage diaphragm shall be installed in accordance to Practice Standard 378 – Pond. Animal guards will be installed on all pipes less than 12 inches in diameter.
2. When the principal and auxiliary spillways are separate, the auxiliary spillway crest will be set 0.5 feet above the crest of the principal spillway. No freeboard is required between the elevation of the peak discharge in the auxiliary spillway and the embankment crest if the downstream embankment slope is 5 horizontal to 1 vertical or flatter. Otherwise, a freeboard of 0.5 feet is required between the elevation of the peak discharge and the crest of the top of embankment. The auxiliary spillway shall be designed to be stable.

For sites with favorable storage conditions, the 25 year peak discharge may be flood routed to reduce the size of the auxiliary spillway.

When the spillway is vegetated it will be located in natural, undisturbed soil. Rock lined spillways will have geotextile installed prior to placing riprap.

The standards and specification for Dike (356), Structure for Water Control (587), Pond (378), and Wetland Wildlife Habitat Management (644) will be used as appropriate. Refer to Engineering Field Handbook, Chapter 13, "Wetland Restoration, Enhancement, and Creation", and Chapter 6, "Structures" for additional design information.

Existing drainage systems will be utilized, removed or modified as needed to achieve the intended purpose.

Criteria for Depressions

Undisturbed wetland systems typically consist of complexes that contain a diversity of topographic relief with wet depressions and upland islands. When wetlands are drained or altered, they normally lose most of their micro and macro topographic relief through land leveling or other agricultural activities. The following criteria will be used to establish wet depressions within the wetland restoration project area. Refer to *Using Micro and Macrotopography in Wetland Restoration*, Indiana NRCS Biology Technical Note 1 for additional information.

1. If original conditions cannot be determined from historical aerial photography or other sources, depression size, depth, shape and density should be based upon conditions existing in reference wetlands. This may include oxbows and other depressional areas typical of floodplain forests. Unless original conditions indicate otherwise, depressions will have varying depth with a maximum of 4 feet of excavation. A minimum of 2/3 of the surface area of the constructed depression will have varying depths from 6 inches to no more than 18 inches.
2. Depression side slopes will be gentle with a minimum of 50% of side slope area being graded to 6:1 (6 horizontal to 1 vertical) or flatter. The remaining side slope area will have to be 3:1 or flatter.
3. Depressions will be irregular in shape to maximize edge effect and provide additional cover for waterfowl, amphibians, reptiles and other wetland dependent species utilizing the site.
4. Surface drainage into the depression will be maintained.
5. When depressions are connected by meander channels; the channels shall have:
   - minimum excavated depth of 1 foot,
   - maximum depth that is 1 foot less than that of the pothole,
   - side slopes not steeper than 3:1.

Criteria for Subsurface Drain Removal or Destruction

In areas where subsurface drains were installed to remove surface and/or subsurface water, the existing system will be modified to restore the wetland hydrologic condition. Review of design records, interviews, and site investigations will be needed to determine the extent of the existing system.

The effect of a subsurface drainage system will be eliminated by the following:

1. remove and render inoperable a portion of the drain at the downstream edge of the site.
2. modify the drain with a water control device; or
3. replace the drain with non-perforated pipe through the wetland site.

The minimum length of drain to be removed or rendered inoperable shall be as shown in Table 1.

If needed, the ends of the disturbed drain shall be capped and buried to keep sediment and rodents from entering the drain.

Provisions shall be made to maintain drainage system integrity both upstream and downstream of the wetland as necessary.

Bedding, filtering and/or flow enhancing material will be removed if necessary. The resulting trench shall be filled with compacted earth to a density of the adjacent soil.

Criteria for Surface Drain Removal (Ditch Plug)

Where surface drains were constructed to drain wetlands, the drain can be plugged with earth to restore the wetland hydrology. A water control structure may be used to manipulate water levels for vegetation management.

The installation of a plug shall not cause accelerated erosion or flooding. Flow water shall be diverted around the ditch plug on vegetated undisturbed soil, or flow over the ditch plug in areas reinforced with geotextile and stone, or through an erosion resistant water control structure.

All fill shall be earth compacted to the approximate density of the adjacent soil material.

The height of the plug shall be at least 1 foot higher than the low bank of the ditch. The maximum plug height from ditch bottom shall be 6 feet.

The width of the plug shall be at least two times the channel top width, measured perpendicular to the flow.

The length of the plug shall be at least 20 feet measured parallel to the ditch flow direction.

All slopes shall be 5 to 1 or flatter.

Increase fill height to compensate for settling. A minimum of 5 percent for mineral soils and 33 percent for organic soils shall be used.

When appropriate, the ditch can be filled along the entire extent, or along some portion of its extent. Ditch filling should always commence from the upslope end and then downstream from that point.

The ditch plug and all disturbed areas shall be seeded according to Practice Standard 342 – Critical Area Planting.

Criteria for Vegetative Restoration

Hydrophytic vegetation restoration shall be of species typical for the wetland type(s) being established. Preference shall be given to native wetland plants with localized genetic material. Refer to *Wetland, Woodland, Wildland – A Guide to the Natural Communities of Vermont* and comparison soils guide to determine likely plant composition of the wetland to be restored. Document natural communities and plant composition in nearby natural wetlands in similar landscape position to further support the vegetation restoration plan. Species and habitats of concern should be considered when developing vegetation restoration plans.

Where natural colonization of pre-identified, selected species will realistically dominate within 5 years, sites may be left to revegetate naturally. If a site has not become dominated by the targeted species within 5 years, active forms of revegetation may be required.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the design.

Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based upon the type of vegetative communities present and the vegetation type planned:

- Where the dominant vegetation will be herbaceous community types, a subset of the original vegetative community shall be established within 5 years; or, a suitable precursor to the original community will be established within 5 years that creates conditions suitable for the establishment of the native community. Species richness shall be addressed in the planning of herbaceous communities.
- Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a minimum of six species. Tree and/or shrub planting (by seed, shoot, or seedling) and site preparation will follow Practice Standard 612 – Tree/Shrub Establishment. It is expected that for wildlife purposes, planting density and

stocking rates will generally be lower than for production purposes, and that the selection of species will generally be different than species for production purposes.

Seeding rates shall be based upon percentage of pure live seed that shall be tested within 6 months of planting.

CONSIDERATIONS

All necessary local, state, and federal permits shall be obtained by the landowner (or representative) prior to the restoration.

It is expected that for wildlife purposes, planting density and stocking rates will generally be lower than for production purposes, and that the selection of species will generally be different than those used for production purposes.

On sites where woody vegetation will dominate, consider adding 1 to 2 dead snags, tree stumps or logs per acre to provide structure and cover for wildlife and a carbon source for food chain support.

Consider impact that water surface draw-downs will have on concentrating aquatic species such as turtles into diminished pool area resulting in increased mortality.

Consider existing wetland functions and/or values that may be adversely impacted.

Consider the effect restoration will have on disease vectors such as mosquitoes.

Consider effect of volumes and rates of runoff, infiltration, evaporation and transpiration on the water budget.

Consider effects on downstream flows or aquifers that would affect other water uses or users.

Consider the effect of water control structures on the ability of fish or other aquatic species to move in and out of the wetland.

Consider the development of a written management plan associated with the installation of a water control structure. When draw downs or impounding are most beneficial for given focus plant and animal species, etc.

Consider stripping and stockpiling topsoil, then replacing over disturbed areas and shallow areas, for a source of seeds and seeding establishment.

Consider establishing herbaceous vegetation by a variety of methods over the entire site, or a portion of the site, and at densities and depths appropriate.

Consider effects on wetlands and water-related resources, including fish and wildlife habitats, which would be associated with the practice.

Consider linking wetlands by corridors wherever appropriate to enhance the wetland's use and colonization by the native flora and fauna.

Consider establishing vegetative buffers on surrounding uplands to reduce sediment and soluble and sediment-attached substance carried by runoff and/or wind.

The nutrient and pesticide tolerance of the species planned should be considered where known nutrient and pesticide contaminants exist.

Consider effects on temperature of water resources to prevent undesired effects on aquatic and wildlife communities.

Consider the effects of soil disturbance and probability of invasion by unwanted species.

Consider using seeding mixtures for wildlife purposes found in Plant Materials Technical Note NY – 36 (VT PM Technote – 1), Wildlife Seed Mixtures for Grassland Habitat Restoration.

For discharge wetlands, consider underground upslope water and/or groundwater source availability.

Consider microtopography and hydroperiod when determining which species to plant.

Biological control of undesirable plant species and pests (eg. using predator or parasitic species) shall be implemented where available and feasible.

Consider controlling water levels to prevent oxidation of organic soils and inundated organic matter and materials.

Consider the negative effects that level ditches (between depressions) may have on amphibians where they may provide access for fish; particularly when connecting depressions to deeper, more permanent pools.

PLANS AND SPECIFICATIONS

All projects will have a Wetland Restoration Plan developed that uses the approved Vermont template. This template includes goals and objectives, current site conditions, historic site conditions, species and habitats of special concern, targeted natural communities, planned practices, management considerations, and monitoring requirements. Specifications for this practice shall be prepared for each site. Specifications shall be recorded using approved specifications sheets, job sheets, narrative statements in the Wetland Restoration Plan, or other documentation. Requirements for the operation and maintenance of the practice shall be incorporated into site specifications. Plans and specifications should be reviewed by staff with appropriate training in design and implementation of wetland restoration.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

Any use of fertilizers, mechanical treatments, prescribed burning, pesticides and other chemicals shall assure that the intended purpose of the wetland restoration shall not be compromised;

Establish an inspection schedule for embankments and structures for damage assessment;

The depth of accumulated sediment should be measured and the accumulations removed when the planned project objectives are jeopardized.

Management actions shall maintain vegetation, and control undesirable vegetation.

For wildlife habitat purposes, haying and mowing, if justified as a necessary wildlife/wetland management tool, can be used for management of vegetation. Disturbance to ground nesting species shall be minimized.

Water control structures will be managed to benefit target plants and animal species.

The control of water depth and duration may be utilized to control unwanted vegetation.

REFERENCES:

Invasive Species, Executive order 13112, February 3, 1999. Federal Register: Vol.64, No.25. Feb. 8, 1999.

Wetland Restoration Enhancement, or Creation, Chapter 13, Engineering Field Handbook, pp. 3, 24, 77, 78, USDA-NRCS

Wetland Restoration, Enhancement, Management & Monitoring, ECS 190-15, pp. 425, USDA-NRCS, 2003

Field Indicators of Hydric Soils in the U.S., Version 6.0, G.W. Hurt, P.M. Whited and R.F. Pringle (editors), USDA-NRCS in cooperation with the National Technical Committee for Hydric Soils, Fort Worth, TX, 2006

Aquic Conditions and Hydric Soils: The Problem Soils, M.J. Vepraskas ands S. W. Sprecher editors, 1997, Soil Science Society of America Special Publication Number 50 SSSA, Inc. Madison, WI

Habitat Management Guidelines for Amphibians and Reptiles of the Northeast, J.C. Mitchell, A.R. Breisch, and K.A. Buhlmann 2006, Partners in Amphibian & Reptile Conservation, Technical Publication HMG-3, pp. 108, Montgomery, AL

Functional Requirements and Design Parameters for Restocking Coarse Woody Features in Restored Wetlands, Justin T. Maschhoff & James H. Dooley, 2001. ASAE Meeting Presentation, Paper No: 012059

Wildlife Seed Mixtures for Grassland Habitat Restoration, Plant Material Technical Note NY-36, USDA-NRCS, May 2006

Managing Your Restoration Wetland, C.A. Cole, T.L. Serfass, M.C. Brittingham, and R.P. Brooks, College of Agricultural Sciences Cooperative Extension – Pennsylvania State University, 1996

Using Micro and Macrotopography in Wetland Restoration, Indiana NRCS Biology Technical Note – 1, October 2000